

The Environmental Protection Agency is proposing to add a new part 197 to Subchapter F of Chapter I, title 40 of the Code of Federal Regulations, as follows:

SUBCHAPTER F--RADIATION PROTECTION PROGRAMS

**PART 197--ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR
YUCCA MOUNTAIN, NEVADA**

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Authority: Sec. 801, Pub. L. 102-486, 106 Stat. 2921, 42 U.S.C. 10141 n.

Subpart A--Environmental Standards for Storage

§ 197.01 What does subpart A cover?

This subpart covers the storage of radioactive materials by DOE in the Yucca Mountain repository and on the Yucca Mountain site.

§ 197.02 What definitions apply in subpart A?

Annual committed effective dose equivalent means the committed effective dose equivalent plus the effective dose equivalent received by an individual in one year from radiation sources external to the individual.

Committed effective dose equivalent means the total effective dose equivalent received by an individual from radionuclides internal to the individual following a one-year intake of those radionuclides.

DOE means the Department of Energy.

Effective dose equivalent means the sum over specified tissues of the products of the dose equivalent received following an exposure of, or an intake of radionuclides into, specified tissues of the body, multiplied by appropriate weighting factors.

EPA means the Environmental Protection Agency.

General environment means everywhere outside the Yucca Mountain site, the Nellis Air Force Range, and the Nevada Test Site.

High-level radioactive waste means high-level radioactive waste as defined in the Nuclear Waste Policy Act of 1982 (Pub. L. 97-425).

Member of the public means anyone who is not a radiation worker for purposes of worker protection.

NRC means the Nuclear Regulatory Commission.

Radioactive material means matter composed of or containing radionuclides subject to the Atomic Energy Act of 1954, as amended. Radioactive material includes, but is not limited to, high-level radioactive waste and spent nuclear fuel.

Spent nuclear fuel means spent nuclear fuel as defined in the Nuclear Waste Policy Act of 1982 (Pub. L. 97-425).

Storage means retention (and any associated activity, operation, or process necessary to carry out successful retention) of radioactive material with the intent or capability to readily access or retrieve such material.

Yucca Mountain repository means the mined portion of the facility constructed underground within the Yucca Mountain site.

Yucca Mountain site means the site recommended by the Secretary of DOE to the President under section 112(b)(1)(B) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10132(b)(1)(B)) on May 27, 1986.

§ 197.03 How is subpart A implemented?

The NRC implements this subpart. The DOE must demonstrate to NRC that operations on the Yucca Mountain site will occur in compliance with this subpart before NRC may grant to DOE a license to receive and possess radioactive material on the Yucca Mountain site.

§ 197.04 What is DOE required to do relative to stored radioactive material?

(a) The DOE must ensure that no member of the public in the general environment receives more than an annual committed effective dose equivalent of 150 microsieverts (15 millirems) from the combination of:

- (1) Management and storage (as defined in 40 CFR 191.02) of radioactive material which:
 - (i) is subject to 40 CFR 191.03(a); and

(ii) occurs outside of the Yucca Mountain repository but within the Yucca Mountain site;
and

(2) Storage (as defined in § 197.02) of radioactive material inside the Yucca Mountain repository.

§ 197.05 When will this part take effect?

The standards in this part take effect on [sixty days after publication of the final standards in the Federal Register].

Subpart B--Environmental Standards for Disposal

Introduction

§ 197.11 What does subpart B cover?

This subpart covers the disposal of waste in Yucca Mountain by DOE.

§ 197.12 What definitions apply in subpart B?

All definitions in subpart A of this part and the following:

Active institutional control means controlling access and/or performing work on the Yucca Mountain site by any means other than passive institutional controls.

Aquifer means an underground geological formation, group of formations, or part of a formation that can yield a significant amount of water to a well or spring.

Barrier means any material, structure, or feature that, for a period to be determined by NRC, prevents or substantially reduces the rate of movement of water or radionuclides from the Yucca Mountain repository, or prevents the release or substantially reduces the release rate of radionuclides from the waste. For example, a barrier may be a geologic feature, an engineered structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around the waste, provided that the material substantially delays movement of water or radionuclides.

Controlled area means:

(1) A surface area, identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the repository footprint; and

(2) The subsurface underlying the surface area. **[This definition would be included only if Alternative 1 for § 197.37 were chosen.]**

Controlled area means:

(1) A surface area, identified by passive institutional controls, that extends horizontally no more than five kilometers in any direction from the repository footprint except that DOE may include in the controlled area any contiguous area within the boundary of the Nevada Test Site (as established as of the date of promulgation of this part); and

(2) The subsurface underlying the surface area. **[This definition would be included only if Alternative 4 for § 197.37 were chosen.]**

Disposal means emplacement of radioactive material into the Yucca Mountain disposal system with the intent of isolating it for as long as reasonably possible and with no intent of

recovery, whether or not the design of the disposal system permits the ready recovery of the material. Disposal of radioactive material in the Yucca Mountain disposal system begins when all of the ramps and other openings into the Yucca Mountain repository are backfilled and sealed.

Ground water means water below the land surface and in a saturated zone.

Human intrusion means breaching of any portion of the Yucca Mountain disposal system by human activity.

Passive institutional controls means:

- (1) Markers, as permanent as practicable, placed on the Earth's surface;
- (2) Public records and archives;
- (3) Government ownership and regulations regarding land or resource use; and
- (4) Other reasonable methods of preserving knowledge about the location, design, and contents of the Yucca Mountain disposal system.

Peak dose means the highest annual committed effective dose equivalent projected to be received by the reasonably maximally exposed individual.

Performance assessment means an analysis that:

- (1) Identifies the processes, events, and sequences of processes and events (except human intrusion), and their probabilities of occurring over 10,000 years after disposal, that might affect the Yucca Mountain disposal system;
- (2) Examines the effects of those processes, events, and sequences of processes and events upon the performance of the disposal system; and
- (3) Estimates the annual committed effective dose equivalent received by the reasonably maximally exposed individual, including the associated uncertainties, as a result of releases caused

by all significant processes, events, and sequences of processes and events.

Period of geologic stability means the time during which the variability of geologic characteristics and their future behavior in and around the Yucca Mountain site can be bounded, that is, they can be projected within a reasonable range of possibilities.

Plume of contamination means that volume of ground water that contains radioactive contamination from releases from the Yucca Mountain disposal system. It does not include releases from any other potential sources on or near the Nevada Test Site.

Point of compliance is the place where DOE must project the amount of radionuclides in the ground water for purposes of § 197.35. The point of compliance is located above the highest concentration in the plume of contamination as specified in § 197.37.

Repository footprint means the outline of the outermost locations of where the waste is emplaced in the Yucca Mountain repository.

Slice of the plume means a cross-section of the plume of contamination with sufficient thickness parallel to the prevalent flow of the plume that it contains the representative volume.

Total dissolved solids means the total dissolved (filterable) solids in water as determined by use of the method specified in 40 CFR part 136.

Undisturbed performance means that human intrusion or the occurrence of unlikely, disruptive, natural processes and events do not disturb the disposal system.

Waste means any radioactive material emplaced for disposal into the Yucca Mountain disposal system.

Well-capture zone means the volume from which a well pumping at a defined rate is withdrawing water from an aquifer. The dimensions of the well-capture zone are determined by

the pumping rate in combination with aquifer characteristics assumed for calculations, such as hydraulic conductivity, gradient, and the screened interval.

Yucca Mountain disposal system means the combination of underground engineered and natural barriers at the Yucca Mountain site which prevents or substantially reduces releases from the disposed radioactive material.

§ 197.13 How is subpart B implemented?

The NRC implements subpart B. In the case of the specific numerical requirements in this subpart, NRC will determine compliance based upon the mean or median (whichever is higher) of the highest results of DOE's performance assessments projecting the performance of the Yucca Mountain repository for 10,000 years after disposal. The DOE must demonstrate to NRC that there is a reasonable expectation of compliance with this subpart before NRC can issue a license.

§ 197.14 What is reasonable expectation?

Reasonable expectation means that the Commission is satisfied that compliance will be achieved based upon the full record before it. Reasonable expectation:

(a) Requires less than absolute proof because absolute proof is impossible to attain for disposal due to the uncertainty of projecting long-term performance;

(b) Is less stringent than the reasonable assurance concept that NRC uses to license nuclear power plants;

(c) Takes into account the inherently greater uncertainties in making long-term projections of the performance of the Yucca Mountain disposal system;

(d) Does not exclude important parameters from assessments and analyses simply because they are difficult to precisely quantify to a high degree of confidence; and

(e) Focuses performance assessments and analyses upon the full range of defensible and reasonable parameter distributions rather than only upon extreme physical situations and parameter values.

§ 197.15 How must DOE take into account the changes that will occur during the next 10,000 years?

The DOE should not attempt to project changes to society, human biology, or increases or decreases to human knowledge. In all analyses done to demonstrate compliance with this part, DOE must assume that all of those factors remain constant as they are at the time of license submission to NRC. However, DOE must vary factors related to the geology, hydrology and climate based on environmentally protective but reasonable scientific predictions of the changes that could affect the Yucca Mountain disposal system over the next 10,000 years.

Individual-Protection Standard

§ 197.20 What standard must DOE meet?

The DOE must demonstrate, using performance assessment, that there is a reasonable expectation that for 10,000 years following disposal the reasonably maximally exposed individual receives no more than an annual committed effective dose equivalent of 150 microsieverts (15 mrem) from releases from the undisturbed Yucca Mountain disposal system. The DOE's analysis

must include all potential pathways of radionuclide transport and exposure.

§ 197.21 Who is the reasonably maximally exposed individual (RMEI)?

The RMEI is a hypothetical person who could meet the following criteria:

(a) Based upon current understanding, lives within one-half kilometer of the junction of U.S. Route 95 and Nevada State Route 373, unless NRC determines that the RMEI would receive a higher dose living in another location at the same distance from the Yucca Mountain repository;

(b) Has a diet and living style representative of the people who are now residing in the Town of Amargosa Valley, Nevada. The DOE must use the most accurate projections which might be based upon surveys of the people residing in the Town of Amargosa Valley, Nevada, to determine their current diets and living styles and use the mean values in the assessments conducted for §§ 197.20 and 197.25; and

(c) Drinks 2 liters of water per day from wells drilled into the ground water at the location where the RMEI lives.

Human-intrusion Standard

§ 197.25 What standard must DOE meet?

Alternative 1 for § 197.25

The DOE must demonstrate that there is a reasonable expectation that for 10,000 years following disposal the reasonably maximally exposed individual receives no more than an annual

committed effective dose equivalent of 150 microsieverts (15 mrem) as a result of a human intrusion. The DOE's analysis of human intrusion must include all potential environmental pathways of radionuclide transport and exposure.

Alternative 2 for § 197.25

The DOE must determine the earliest time after disposal that the waste package would degrade sufficiently that a human intrusion (see § 197.26) could occur without recognition by the drillers. The DOE must:

(a) demonstrate that there is a reasonable expectation that the reasonably maximally exposed individual receives no more than an annual committed effective dose equivalent of 150 microsieverts (15 mrem) as a result of a human intrusion, if complete waste package penetration can occur at or before 10,000 years after disposal. The analysis must include all potential environmental pathways of radionuclide transport and exposure; and

(b) include the results of the analysis and its bases in the environmental impact statement for Yucca Mountain as an indicator of long-term disposal system performance, if the intrusion cannot occur before 10,000 years after disposal.

§ 197.26 What are the circumstances of the human intrusion?

For the purposes of the analysis of human intrusion, DOE must make the following assumptions:

- (a) There is a single human intrusion as a result of exploratory drilling for ground water;
- (b) The intruders drill a borehole directly through a degraded waste container into the

uppermost aquifer underlying the Yucca Mountain repository;

(c) The drillers use the common techniques and practices that are currently employed in the region surrounding Yucca Mountain;

(d) Careful sealing of the borehole does not occur, instead natural degradation processes gradually modify the borehole;

(e) Only releases of radionuclides that occur as a result of the intrusion and that are transported through the resulting borehole to the saturated zone are projected;

(f) No releases are included which are caused by unlikely natural processes and events; and

[Paragraph (g) would be included only if Alternative 1 for § 197.25 is chosen.]

(g) The intrusion occurs at a time or within a range of time determined by NRC. The NRC must make that determination based upon the following factors:

(1) The earliest time that current drilling techniques could lead to waste package penetration without recognition by the drillers;

(2) The time it would take for a small percentage of waste packages to fail but before significant migration of radionuclides has occurred; and

(3) Intrusion would not occur during the period of active institutional control.

Other Considerations

§ 197.30 What other projections must be made by DOE?

To complement the results of § 197.20, DOE must calculate the peak dose of the

reasonably maximally exposed individual that would occur after 10,000 years following disposal but within the period of geologic stability. While no regulatory standard applies to the results of this analysis, DOE must include the results and their bases in the environmental impact statement for Yucca Mountain as an indicator of long-term disposal system performance.

Ground Water Protection Standards

§ 197.35 What standards must DOE meet?

In its license application to NRC, DOE must provide a reasonable expectation that, for 10,000 years of undisturbed performance after disposal, releases of radionuclides from radioactive material in the Yucca Mountain disposal system will not cause the level of radioactivity in the representative volume of ground water at the point of compliance to exceed the limits in Table 1 as follows:

Table 1. Limits on radionuclides in the representative volume.

Radionuclide or type of radiation emitted	Limit	Is natural background included?
Combined radium-226 and radium-228	5 picocuries per liter	Yes
Gross alpha activity (including radium-226 but excluding radon and uranium)	15 picocuries per liter	Yes
Combined beta and photon emitting radionuclides	40 microsieverts (4 millirem) per year to the whole body or any organ	No

§ 197.36 What is a representative volume?

(a) It is the volume of ground water that would be withdrawn annually from an aquifer containing less than 10,000 milligrams of total dissolved solids per liter of water to supply a given water demand. The DOE must project the concentration of radionuclides from the Yucca Mountain repository that will be in the representative volume. The DOE must then use the projected concentrations to demonstrate to NRC compliance with § 197.35. The DOE must make the following assumptions concerning the representative volume:

(1) It is centered on the highest concentration level in the plume of contamination at the point of compliance;

(2) Its position and dimensions in the aquifer are determined using average hydrologic characteristics for the aquifers along the radionuclide migration path from the Yucca Mountain repository to the compliance point as determined by site characterization; and

(3) It contains 1285 acre-feet of water (about 1,591,023,000 liters or 418,690,000 gallons).

(b) The DOE must use one of two alternative methods for determining the dimensions of the representative volume. The DOE must propose the method, and any underlying assumptions, to NRC for approval.

(1) The dimensions may be calculated as a well-capture zone. If this approach is used, DOE must assume that the:

(i) Water supply well has characteristics consistent with public water supply wells in Amargosa Valley, Nevada, for example, well bore size and length of the screened intervals;

(ii) Screened interval is centered in the highest concentration in the plume of

contamination at the point of compliance; and

(iii) Pumping rate is set to produce an annual withdrawal equal to the representative volume.

(2) The dimensions may be calculated as a slice of the plume. If this approach is used, DOE must:

(i) Propose to NRC, for its approval, where the location of the edge of the plume of contamination occurs. For example, the place where the concentration of radionuclides reaches 0.1% of the level of the highest concentration at the point of compliance;

(ii) Assume that the slice of the plume is perpendicular to the prevalent direction of flow of the aquifer; and

(iii) Assume that the volume of ground water contained within the slice of the plume is equal to the representative volume.

§ 197.37 Where is the point of compliance?

Alternative 1 for § 197.37:

The point of compliance is any point on the boundary of the controlled area.

Alternative 2 for § 197.37:

The point of compliance is any point within a one-half kilometer radius of the intersection of U.S. Route 95 and Nevada State Route 373. However, if NRC determines that there is another location, at the same distance (approximately 20 kilometers) from the center of the repository

footprint, where the representative volume would have a higher concentration of radionuclides which were released from the Yucca Mountain disposal system, NRC must specify that location the point of compliance.

Alternative 3 for § 197.37:

The point of compliance is any point within the Town of Amargosa Valley, Nevada, and within the area bounded by Frontier Street on the north, Nevada State Route 373 on the east, the Nevada-California border on the south/southwest, and Casada Way on the west (as they are located at the time of promulgation of this part). However, if NRC determines that there is another location, at approximately 30 kilometers, from the center of the repository footprint where the representative volume would have a higher concentration of radionuclides which were released from the Yucca Mountain disposal system, NRC must specify that location as the point of compliance.

Alternative 4 for § 197.37:

The point of compliance is any point on the boundary of the controlled area.

Additional Provisions

§ 197.40 Are there limits on what must be considered in the performance assessments?

Yes. The DOE's performance assessments should not include consideration of processes

or events that are estimated to have less than one chance in 10,000 of occurring within 10,000 years of disposal. The NRC may change this limit to exclude slightly higher probability events. In addition, with the NRC's approval, DOE's performance assessments need not evaluate, in detail, the impacts resulting from any processes and events or sequences of processes and events with a higher chance of occurrence if the results of the performance assessments would not be changed significantly.

§ 197.41 Can EPA amend this rule?

Yes. We can amend this rule by another notice-and-comment rulemaking. However, if we amend this rule, there must be a public comment period of at least 90 days and we must, at a minimum, hold hearings in Washington, D.C. and the Nevada Counties of Nye and Clark.